



ADEPT Live Labs Kent Winter Services

Final Report



In partnership with



Executive Overview

Background and Context

Winter Services comprises a significant component of Local Highway Authority (LHA) operating costs. This is primarily due to the predominant public safety objective of reducing all possible risk to road users, which compels many LHAs to take a blanket approach to gritting, even on marginal nights.

Kent County Council (KCC) is already recognised as a leader in the advancement of Winter Services within the local highways sector, looking at new innovative ways of reducing the size and of its gritting operation. KCC has already invested in sensorising its route network to progress its successful 'Smart Winter' initiative. By applying data science techniques, this preceding project resulted in KCC making wholesale changes to its gritting domains in order to minimise surplus gritting and thereby reduce the overall cost of its gritting operation.



This Live Labs workstream now builds upon this foundation, continuing to leverage data to enable a more intelligence-led winter service operation. While Smart Winter looked at ways to optimise gritting efficiency through domain and route design, this new project aims to further digitalise the gritting operation to enable more effective monitoring of compliance and performance of gritting on this designed network.

As is typical of many Local Authorities, KCC's gritting operation is contracted out, therefore achieving this oversight of the operation involved a lot of integration with third party systems and services. The digital asset platform (HADMS) delivered under Live Labs was a natural fit for facilitating this integrated view of the service.

Approach

Our solution is centred upon digitalising the gritting service by bringing all operating data to a centralised platform where it can enable more rapid and accurate assessment of service performance and associated decision making. The platform itself forms part of the wider HADMS (Highways Asset Data-Led Management Solution) data eco-system. As an overarching objective of the Live Lab, hosting all Live Lab Workstreams on this same platform ensures that all data sets acquired through the various innovation streams can be shared and integrated, thereby bolstering the potential scope of each Workstream.

Our approach in utilising HADMS as the foundation platform is also intended to facilitate easy extension to other Authorities in future, whereby the winter services functionality can be readily configured and deployed into a new Authority with minimum re-work. Based on this design principal, all features and functionality have been carefully vetted by KCC to ensure it is standardised enough to suit general use.

The platform was also envisaged to support decision making, principally around gritting shouts. Originally this had been intended to include the route forecast predictions output by the Smart Winter model, however as KCC already had in place a contract for a weather forecast service for its nightly decision making, this decision output was fed into HADMS, and this workstream focussed instead on subsequent operating compliance and performance. This daily monitoring is important for assuring and demonstrating safety performance, with duty officers being able to monitor on HADMS route completion (compliance) following gritting action. A further aggregated view of longer-term gritting activity helps to motivate and initiate service design improvements.

Business Objective

There are three overarching aims for this Workstream:

- 1) Enable more effective and rapid monitoring of the gritting operation in order to maximise and improve compliance (and thus maximise and improve safety), and to ensure KCC are better equipped with accurate data to defend any public claims for damages.
- 2) Provide improved ready insights into overall and route-specific gritting activities that will equip KCC managers and operators to make better informed assessments of service performance and efficiency, leading to better strategic decision making
- 3) To provision both the above in an efficient automated form that thus eliminates the overhead of manual data processing. This will improve KCC's overall resource efficiency, by significantly reducing the current administrative overhead involved in service monitoring and communications management.

The above objectives are each fulfilled through functional features provided on the HADMS digital interface, as set out in the Solution overview section to follow

Solution

Here we outline the main architectural components and source data feeds of the delivered digital solution:

HADMS Platform

The HADMS cloud architecture provides the foundation for the solution. As well as the underlying structural and functional components (PostGres SQL database, with Flask and React front end) and AWS cloud services used to host and deploy the solution, HADMS also provides the standard design pattern for the solution, whereby this Winter Services solution forms part of a wider platform ecosystem. This ensures that the user experience and functionality is consistent with other workstreams on HADMS, to promote familiarity and minimise the need for specific training.

Mapbox

All HADMS pages are centred around a geospatial view of the KCC estate, to ensure a practical oriented view of the data can be facilitated. This map view is provisioned by the Mapbox Open source package

Gritting Telemetry API

The platform was integrated with the API of KCC's existing fleet service provider Amey (Navtrak) which is updated on an hourly basis. This API can be easily re-pointed at any alternative provider, to suit the service environment, which is an important design factor to ensure extensibility to other local authorities.

Gritting Decision Feed

The gritting decisions are intercepted via email (direct digital receipt). These emails are provided in a consistent digital format to ensure they can be reliably converted into structured data suitable for direct ingestion into the platform.

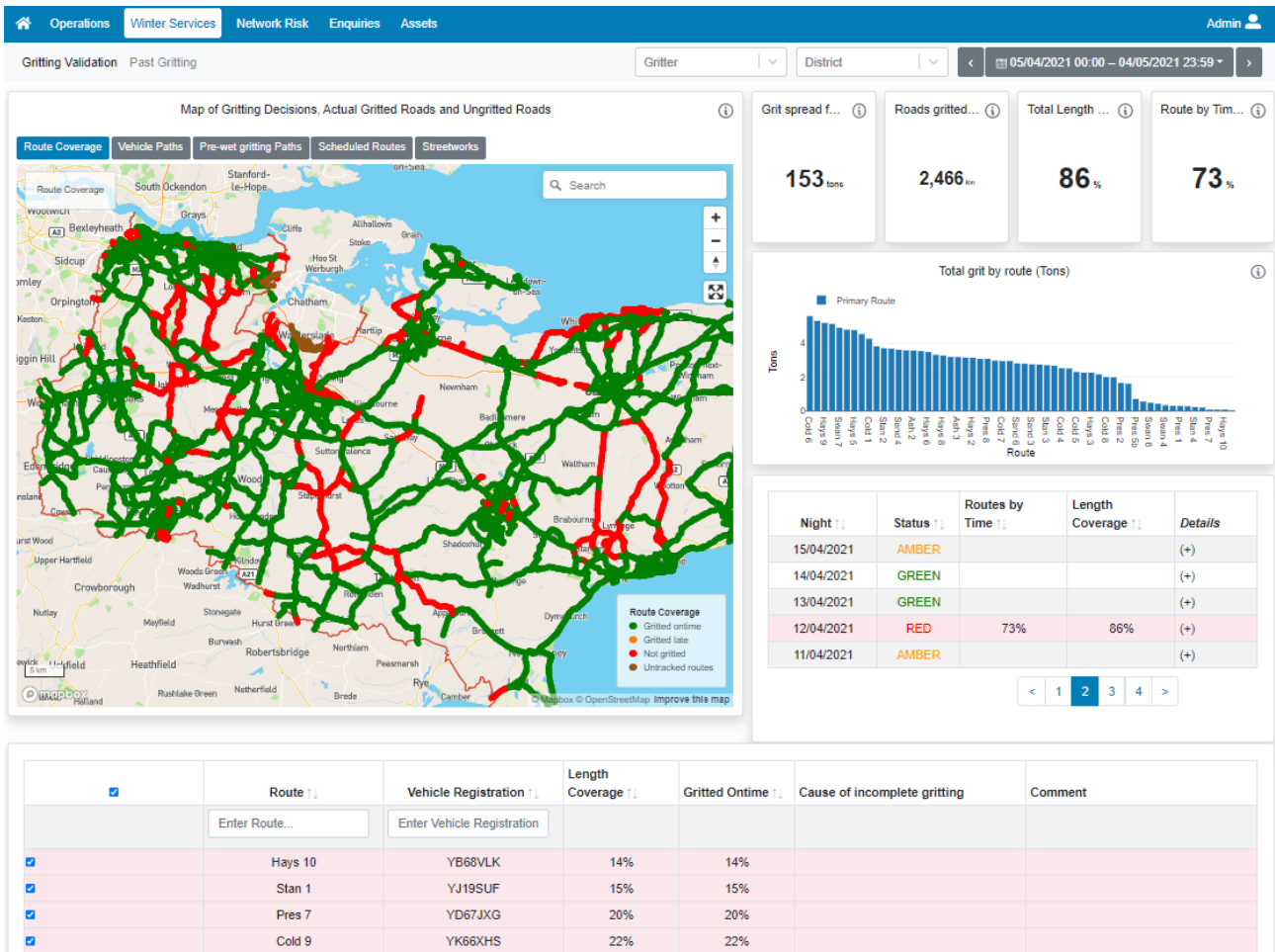
Streetworks API

The Streetworks feed (works and closures) is also integrated to provide an additional context layer for assessing compliance data. Unlike the telemetry feed which is somewhat dedicated to this Winter Services workstream, the Streetworks API has a variety of uses across HADMS.

Gritter routes

All gritting routes all pre-loaded from originating shape files, as provisioned by KCC in conjunction with its fleet management provider, to ensure they comply precisely with the same routes used by gritter drivers to navigate the estate

Below we outline the core functional features of delivered digital solution, as shown in the attached live visual of the built platform. This visual shows the 'Gritting Validation' page as example of the HADMS platform interface design, which is representative of the approach that is consistent across other pages.



Spatial & Temporal Navigation

All functional features are accessed via a standard map-based interface and accompanying date-time control whereby the user can select any desired historical time window. This general interface is consistent with other workstreams on HADMS to provide a uniform consistent experience.

Map Layers

Data sets are generally visualised on a layered basis, whereby the user can select to activate one or more layers of their choosing, with a dedicated reference colour key provided for each layer. The overall geographic view can also be optionally restricted to a single District if desired. Additionally, a search function is provided to enable rapid navigation to a specific location of interest.

Gritting Validation

The gritting validation page displays the decision outcome for each date in the selected date-range, with a RAG-style encoding to indicated dates where gritting took place, and the severity (extent) of the event on each date. Any of these individual gritting event dates can then be selected for inspection.

On selection, the gritting coverage for each route (and each gritter vehicle) is displayed geospatially with a further RAG-style encoding to visually highlight route sections that were omitted or were gritted after the nominated deadline. Additionally, the routes are also ranked in a tabular format in order of compliance (worst to best) with a facility for attributions to be input by a responsible operator, including supplementary text commentary. A defined choice of attributions is provided to ensure consistency and to enable effective future reporting.

These attribution inputs are crucial to building up a ready repository of gritting history, to support communication and claims. Aggregate statistics are also provided for each route (such as tonnage, mileage).

Past Gritting

The past gritting page provides an aggregated view of compliance and averaged coverage statistics over the date-range duration selected. A colour encoding is applied to convey the net coverage over the period enabling the operator to quickly identify route sections that are more frequently missed and should hence be prioritised for investigation.

This page also shows surplus gritting outside designated routes, giving insights into problem areas and logistical challenges faced by gritting drivers. This provides a ready digital representation of the issue to ??

Business Case

The ongoing cost for maintaining and supporting the HADMS platform is minimal – estimated in the region of £7K to £15K per month as the platform is progressively expanded into the KCC operation. This is also a central cost pooled across the various workstreams - accordingly, this Winter Services workstream will constitute only a component of this monthly maintenance fee.

Based on this minimal cost footprint, the following direct and indirect benefits more than justify its ongoing usage. Although these are estimations only, based upon KCC's current operating costs, even allowing for a healthy margin for error the benefits will readily exceed the cost of maintaining the solution:

Benefits in Safety - Improved customer safety through faster identification of non-compliant routes, and hence faster mitigation of issues and/or risks immediately arising. Thus, preventing ensuing incidents

Benefits in Performance - Ready insights into compliance performance provides greater opportunity for improvements in operational planning and logistics to be identified and realised – enabling root causes of non-compliance to be eliminated

Together the above both serve to mitigate incidents through better response, and prevention

Estimated at ~5% x £2M public cost of ice related incidents = ~**£100K** per annum

Benefits in Security - Gritting evidence is ready accessible, ensuring quality accurate information

Together the above both serve to mitigate incidents through reduction in claims exposure and improving outcomes of claims that proceed

Estimated at ~5% x £200K total exposure to associated claims arising = ~**£10K**

Benefits in Efficiency - Gritting evidence is readily accessible, saving time and effort spent gathering data for legal claims against KCC, and greater process velocity in generating the data and reports needed for regular review of compliance and to respond to frequent ad hoc FOI requests

Total FTE time currently spent assembling claim responses = ~**£5K**

~10% x £100K total FTE cost of Operations Management = ~**£10K**

Conclusion & Recommendation

The main benefit of this workstream is in the digitalisation of existing compliance monitoring processes, eliminating the overhead involved in otherwise needing to manually collate multiple disparate data sources. This enables operators to much more rapidly gain and maintain oversight of the operation.

The enduring effectiveness of the delivered solution will be dependent upon the reliability of data feeds (Navtrak in particular) – however even where data feed issues arise, the tool itself enables these data service issues to be identified and mitigated much more rapidly. Thus, in general the solution facilitates much greater awareness and responsiveness by the business to maintain a viable compliance footing.

The platform is now in regular operating use by KCC, with a view to further improvement and expansion. There is also an ambition to expand the solution to other Local Highway Authorities, on the proviso they have also employed a fleet telemetry provider.

This delivered solution opens the opportunity to now bring KCC's decision making mechanism onto the platform (rather than just taking this as a feed), either using its own class leading Smart Winter model, or by integrating KCC's weather forecast provider of choice. This will also provide the added benefit of enabling gritting compliance visuals to be assessed in context with the impacting weather conditions at the time. KCC's RST sensor estate can also be integrated to provide a spot validation of recorded (actual) road conditions alongside each gritting event.

The five cases Live Labs considerations

Strategic case

National, regional and local policy fit: What are the policies that this intervention addresses (key sources – DfT policies, local transport plan, economic plans etc.)?

This innovation fits with the objective of the DfT 2021-22 Outcome Delivery plan to "Build confidence in the transport network... and improve transport users' experience, ensuring that the network is safe, reliable, and inclusive", particularly with a focus on safety and the public confidence that a strong safety record will elicit.

The case for the intervention that meets those policy needs and priorities: How did the intervention address the policies identified?

By rapidly and reliably monitoring the compliance of gritting services, operations managers are able to intervene much more quickly to assess and remediate the root causes of failures in gritting coverage and timeliness. The ready view of overall service performance also enables them to more easily identify systemic issues with gritting service methodology.

The national, regional and local set of background needs and challenges: What were the background challenges that led to the intervention, linking back to the original pitch?

Gritting service data (such as vehicle telemetry and coverage) can already be accessed on a variety of platforms. The challenge for local operators is the time and resource required to access, process and assemble this data which typically involves accessing multiple disparate sources, and particularly the need to do this on an unplanned basis in response to claims or queries – which can make the administration particularly onerous due to its sporadic and ad hoc nature.

The wider case for the intervention in meeting specific local needs and challenges: How did the intervention address those local needs and challenges, what have the successes been in doing so, what have been the failures?

By converging all these sources onto HADMS, operators now have a single point of entry, and a platform which further integrates other contextual data (such as Streetworks) to provide a cohesive view of compliance across the gritting network. As well as general monitoring and reporting, importantly it enables operators to access relevant data quickly and efficiently when needed to respond to queries or issues that may arise. It also puts operators in control to set and maintain their target gritting routes and domains, rather than relying on these being maintained by a third-party provider.

Economic case

The public value of the benefit of the intervention and associated investment: What are the wider benefits realised from the intervention? These can be tangible benefits (such as availability of an asset) or intangible (public confidence)

The core value to the public is through improved safety outcomes that arise from improved compliance management of gritting operations.

The public will also benefit from a more robust and informative response in the event that they wish to raise a concern or claim with the Authority in relation to winter road safety. This in turn will raise public confidence in their Local Authority, making claims less prevalent.

Public costs and benefits analysis: What were the broad costs of the intervention (this does not need to break any commercial confidences and can be broad brush) and what direct benefits did they bring?

The HADMS platform delivery under Live Labs comprised of multiple workstreams, including Network Risk, Winter Services and a range of Operations Management functions. The platform was implemented as a unified programme of works, at a total delivery cost of ~£870K over a 16-month period, inclusive of all initial discovery and engagement, project management, data exploration and technical solution delivery.

Although there is no explicit division of costs, a fair attributable estimate for the Winter Services workstream is ~25% of this effort, or approximately £220K. This is also a one-off solution development cost. It does not require to be repeated for further uptake by other Authorities.

The ongoing cost for maintaining and supporting the HADMS platform is minimal – estimated in the region of £7K to £15K per month as the platform is progressively expanded into the KCC operation. This is also a central cost that will be pooled across the various workstreams including this Winter Services workstream.

Demonstration of benefits through qualitative and quantitative analysis: What are the measurable benefits associated with the intervention that you have observed and measured – this can be qualitative (perceptions, views etc.) and / or quantitative (cost savings, time savings etc.)

Please refer to the earlier **Business Case** section for a detailed coverage of the envisaged benefits. These benefits will need to be measured over an extended period, by assessing gritting coverage and performance over time, and the quantity of claims and negative outcome claims arising over time.

Although these direct and in-direct benefits have only been estimated at this stage, based upon KCC's current operating costs, even allowing for a healthy margin for error these benefits will readily justify its delivery and ongoing usage

Key metrics: What are the wider key metrics – jobs created, people upskilled etc.

These measures are as detailed in the Business Case section:

- Increased gritting coverage (reduced non-compliance)
- Reduced claims reduced negative outcome claims.
- Reduced overhead – operators freed up to focus on their core value-add activities, ultimately improving job satisfaction

Indirect and induced impacts: What have the indirect impacts been of the intervention – unexpected consequences, knock on effects etc.

There have been no unexpected consequences or knock-on effects

Commercial case

Demonstrating that the intervention will result in a viable procurement and attractive deal for the market: What was your procurement journey for the intervention – from specification to deployment?

This innovation was always envisaged as a core component of the wider HADMS digital platform offering. It does not involve any procurement channels, other than the choice of Cloud service provider in AWS (Amazon Web Services) – however this service cost is minimal (under £1,000/month) and the choice of provider largely incidental. Had another provider, such as Google, been utilised this would have had essentially zero impact on the nature or scope of the solution and will have minimal impact on cost.

Rather than other Authorities needing to repeat or emulate our entire solution implementation, which would require software consultancy costs, the premise is that HADMS can simply be offered on a ready built basis, enabling LHAs to gain benefit from the solution with minimal entry costs other than initial integration and minor adaptation if needed.

How did the market respond to the opportunity?

Not applicable. The solution was designed and implemented in-house by Amey Digital Consulting in partnership with KCC

Implementation efficiency: How did you deliver the intervention?

The project was delivered using a standard agile adaptive methodology involving frequent progressive releases of HADMS as the solution evolved over time. This allowed KCC operatives to provide regular feedback to actively guide the solution, thus ensuring the end product is fit for practical operating use and meets the expectations of the business.

What lessons have been learned through delivery?

The importance of keeping the scope contained to the core use case. As part of the wider HADMS digital innovation programme, there was an ambition from early on to deliver further analytical insights and data science by leveraging data sets acquired through platform operation. While this remains an important future roadmap for HADMS, it was crucial to first succeed in operationalising HADMS in KCC, to provide a solid foundation upon which to build out these more advanced innovations.

Another learning relates to integration, particularly with weather forecast service provider. There are a lot of potential alignments with weather data in terms of decision making, monitoring and insights. It would have been beneficial to collaborate earlier with KCC's service partner, to assess and incorporate potential

integration as part of the HADMS service design. It is important to note, however, that KCC were in the process of letting their weather service contract during the Live Labs programme, so logistically this may not have been an ideal time to pursue that objective.

Procurement strategy and delivery schedule: What lessons have been learnt with regards to procurement and market reaction?

The solution was designed and implemented in-house by Amey Digital Consulting in partnership with KCC, so there are no lessons in relation to procurement. However, it is important to note that there are other similar solutions in the market, for example the National Highways SWIS (Severe Weather Information System) that provide similar visualisations of gritting coverage – although this is positioned for use on the SRN. A distinctive benefit of KCC's solution is that it is integrated into a wider data ecosystem, and has been tailored to use by Local operators

Financial case

The intervention is affordable for the public sector and can be funded through a viable financial agreement: In retrospect do you deem the interventions to be affordable, if so why, if not why?

The built digital solution was designed with guidance from KCC to ensure its suitability for general use cases across the wider Authority market. The architecture has been designed to facilitate easy configuration and deployment into other LHAs, with minimum need for customisation and development

Therefore, in terms of future implementations for other Authorities, these should be deliverable at significantly smaller cost, with costs mainly covering integration (adapting to different APIs). Any functional enhancements are anticipated to be minor, and will be carefully vetted to ensure that any new features or processes are suitable for general use by wider Authorities

If deploying again, how might you consider a structuring an at-scale package which could be attractive to the market.

As already explained, a principal purpose of this workstream, and the HADMS platform generally, is to facilitate subsequent extensibility to other LHAs in the wider UK market. It was important to validate and pilot the new functionality within one Authority first, to minimise risk. So even with hindsight, this was the correct approach, which sets the foundation for reliable expansion.

Financial model: If you were implementing again, what considerations would you make in developing your financial model for an at scale set of similar interventions?

Now that we have completed this initial build phase, positioning the winter services package for other LHAs will be fairly straightforward, as it can be structured at a smaller cost limited to configuration and integration into whatever data service environment that LHA happens to occupy.

Funding sources: Besides Live Labs funding have you levered any other funding sources (this can include contributions in kind as well as capital / revenue funds)

An additional £70K was provisioned by KCC for digitisation of its secondary (snow) and tertiary (farmer) network onto the HADMS platform and extending HADMS compliance monitoring functionality to the secondary network.

A further ~£65K was also commissioned with KCC for re-programming and optimisation of its gritting route plan to align with the new domains arising from Smart Winter – although noting that this is a peripheral initiative, connected with Live Labs whereby these new routes are being digitised onto HADMS.

Management case

The intervention can be implemented using best practices in programme and project management: What did you do with regards to project management programming, practices and skills?

The project was run using a hybrid of Prince2 methodology, on top of an agile software delivery framework making use of Azure DevOps functionality. A stage objective delivery programme was set out early on, to guide the overarching delivery, with 2 weekly agile sprints employed to iteratively progress the solution in regular consultation with KCC stakeholders. The end solution was deployed as a pilot initially, in parallel with KCC's existing business processes, in order to validate its fit for usage prior to operationalising into KCC's operating domain.

In retrospect, what would you do differently?

We could have benefited from tighter collaboration with KCC's supply chain partners – particularly those responsible for gritting fleet hardware, and weather forecast provision. Ultimately, we did not have any issues with generally sourcing and integrating data as the project progressed, however its possible such collaboration could have benefited the project in terms of ideation and general planning of the wider connected innovation landscape, to cater for emerging dependencies.

Delivery plan: Thinking back to your original pitch, how did your delivery plan differ from what you planned?

The platform was originally envisaged to additionally support decision making, principally around gritting shouts. This had been intended to include the route forecast predictions output by the Smart Winter model, however as KCC opted to procure a 3rd party weather forecast service for its nightly decision making, this decision output was instead fed into HADMS after the event.

We had also intended from early on to include weather information, alongside the gritting monitoring & performance data. The intention here had been to provide additional context, for example by enabling inspection areas of non-compliance alongside the severity of the conditions that had occurred at the time. This was not essential for core delivery and was always planned as a final value-add feature towards the end of our delivery priorities. Its omission was only due to delivery/budget limitations towards the end of the project – and noting it will have had dependencies on supply chain collaboration.

What lessons have been learnt?

KCC's winter services and supply chain strategies were evolving during the course of the project. This required a degree of flexibility in our delivery in order to adapt to a changing commercial environment. Although Amey Digital were kept abreast of these changes as they occurred, the project could have benefited from being made aware of KCC's broader strategic vision at an earlier stage. It should be noted, however, that this would have introduced the risk that this vision may not have fully materialised, so it is a difficult balance to strike

Project management team and qualifications: In retrospect, what roles, skills and qualifications would a deliver team need to deliver this intervention at scale elsewhere?

To repeat or emulate our entire solution implementation will require skilled IT/software consultancy capability. Our particular choices of framework (in SQL, React and Bootstrap) and cloud platform (AWS) are

arbitrary – whatever framework is chosen, competent database and application developers will be required. However, the whole premise of implementing HADMS, is that this platform can now simply be offered on a ready built basis, enabling LHAs to avoid such implementation effort, and gain benefit from the solution with minimal entry costs other than initial integration and minor adaptation if needed.

Ex-ante evaluation strategy: Did you undertake an evaluation of alternatives to the intervention?

We did undertake desktop research into available solutions for compliance monitoring, with focus particularly on established players (such as Exactrak). At the time of inception there was no immediate offering in the market, and especially none that offered the customisation needed to incorporate KCC's nightly decision feed

If undertaking a similar programme at scale, what alternatives would you consider, what scenarios might you consider them within?

We are working in a fast-moving industry, with a complex and dynamic supply chain that is increasingly adapting to new technology and software capabilities. If we were to repeat this project again, we would need to undertake a significant phase of industry engagement to carefully position our solution within the current environment. It could well be the case that the solution, as currently delivered, is still a unique offering for Local Authorities, but in either case we would look to incorporate a weather data service in some form to provide additional context for the compliance monitoring